A COMPREHENSIVE VISION OF INCREASING THE VALUE AND USES OF ALFALFA AND FORAGES

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Abstract

U.S. farmers harvested alfalfa (*Medicago sativa*) for hay or haylage from 24.5million acres in 2009. However, acreage is stable to declining. Alfalfa provides an excellent source of fiber, protein, minerals and vitamins that partially or completely meet various classes of ruminant livestock nutrient needs. Alfalfa has considerable potential as a feedstock for production of liquid fuel and other industrial materials because of its high biomass production, perennial nature, ability to provide its own nitrogen fertilizer, and valuable co-products. Alfalfa stems are an excellent feedstock for cellulosic ethanol via fermentation or gasification. Fractionation processes can produce alfalfa leaf meal (ALM) with protein content comparable to protein in dried distiller's grains. Adding high value products from either fraction of alfalfa from non livestock uses will add value to alfalfa biomass use for Biofuels. When a biomass-type alfalfa is grown under a biomass management system with less dense seeding and only two harvests per year, compared with standard hay-type alfalfa production practices, total yield of alfalfa increases 42%, leaf protein yield is equal, and potential ethanol yield from stems doubles. If alfalfa could be engineered to increase the extent of fiber digestion the amount of energy derived from cattle diets would increase or the potential amount of carbohydrate available for cellulosic ethanol fermentation could increase; each of which has potential to increase the demand for alfalfa. Higher value livestock feed, potential for a new cellulosic feedstock and potential to reduce the number of cuttings per season supports the need for alfalfa variety improvement. The Consortium for Alfalfa Improvement (CAI) is a partnership model of government, private non-profit and private profit entities needed to advance long-term, high risk science that potentially will develop large payoffs for ruminant livestock producers. The CAI has been committed to redesigning alfalfa for dairy cattle, reduction of cell wall lignin and reduction protein degradation during fermentation. Proof of concept reduced-lignin transgenic alfalfa hay fed in total mixed diets with corn silage measured increased fiber digestibility in both lactating dairy cows and rapidly growing lambs. Digestible dry matter of one transgenic increased 3.5 % fat corrected milk over the same plant population without the reduced-lignin gene by 2.86 lb/hd/day. Alfalfa stems from reduced lignin genotypes increased sugar yield which potentially could increase ethanol > 50% compared to standard alfalfa. Two reduced lignin transgenic alfalfa populations were compared to appropriate controls and grown in diverse environments. Harvests were taken beginning at late vegetative stage and continued at 5 day intervals for 5 total harvests. Late harvested COMT and CCOMT lines had the same neutral detergent fiber digestibility as their control populations harvested 8 to 12 days earlier. Producers using this trait may be able to delay harvest while maintaining forage quality, potentially eliminating one or more annual harvests while increasing yield by 20 to 30%.

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